

US EPA ARCHIVE DOCUMENT



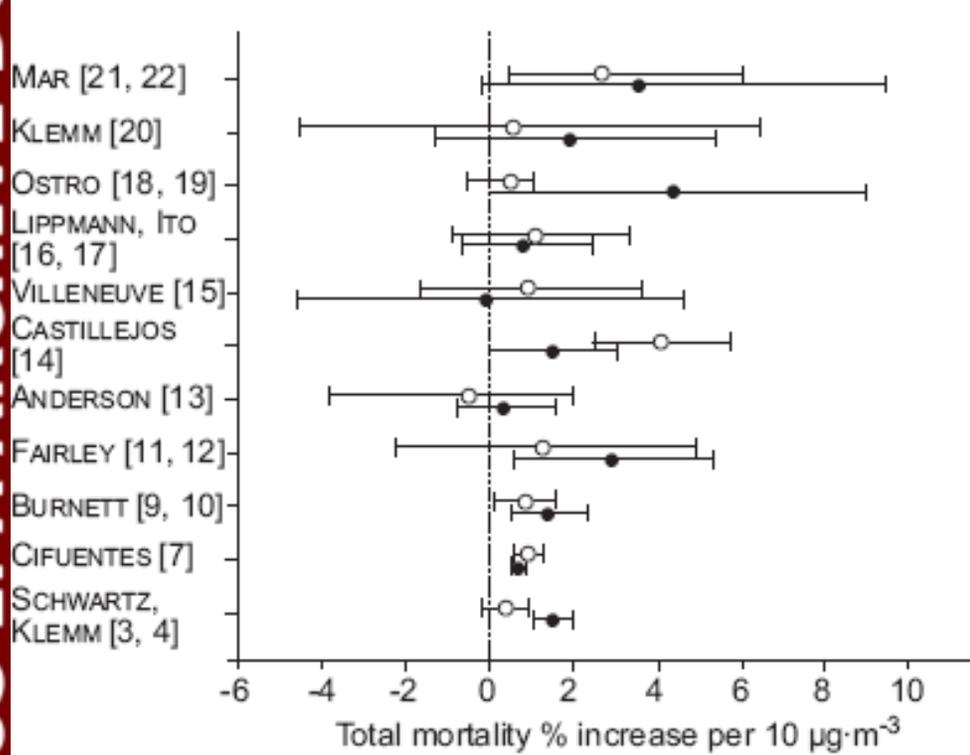
# Why?

Eur Respir J 2005; 26: 309-318  
 DOI: 10.1183/09031936.05.00001805  
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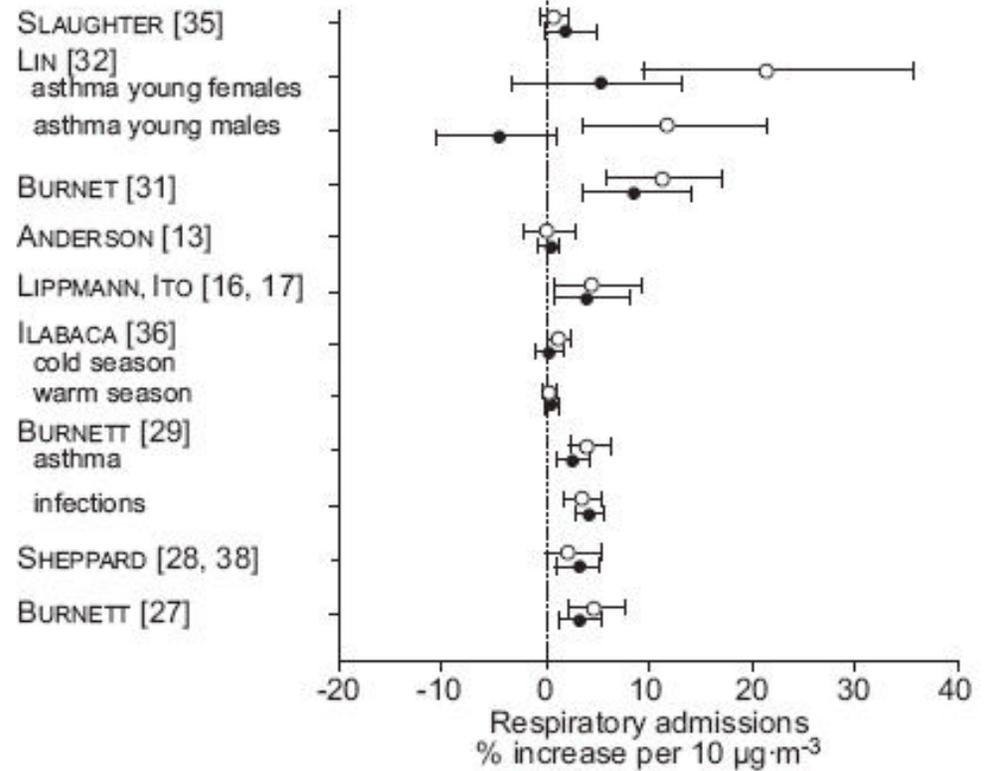
## REVIEW

# Epidemiological evidence of effects of coarse airborne particles on health

B. Brunekreef\* and B. Forsberg#



**FIGURE 1.** Effect of fine (●) and coarse (○) particles on total mortality published time series studies.



**FIGURE 2.** Effect of fine (●) and coarse (○) particles on respiratory admissions in published time series studies.

# Challenges

- Reproducible effect?
- Urban effect only?
- Spatial heterogeneity?

# Health Effects & Characterization of Urban and Rural PM<sub>coarse</sub> in NE Colorado

CU – M. Hannigan, J. Milford, S. Miller

CSU – J. Peel

Mines – W. Navidi

UWisc – J. Schauer

UWash – S. Vedal



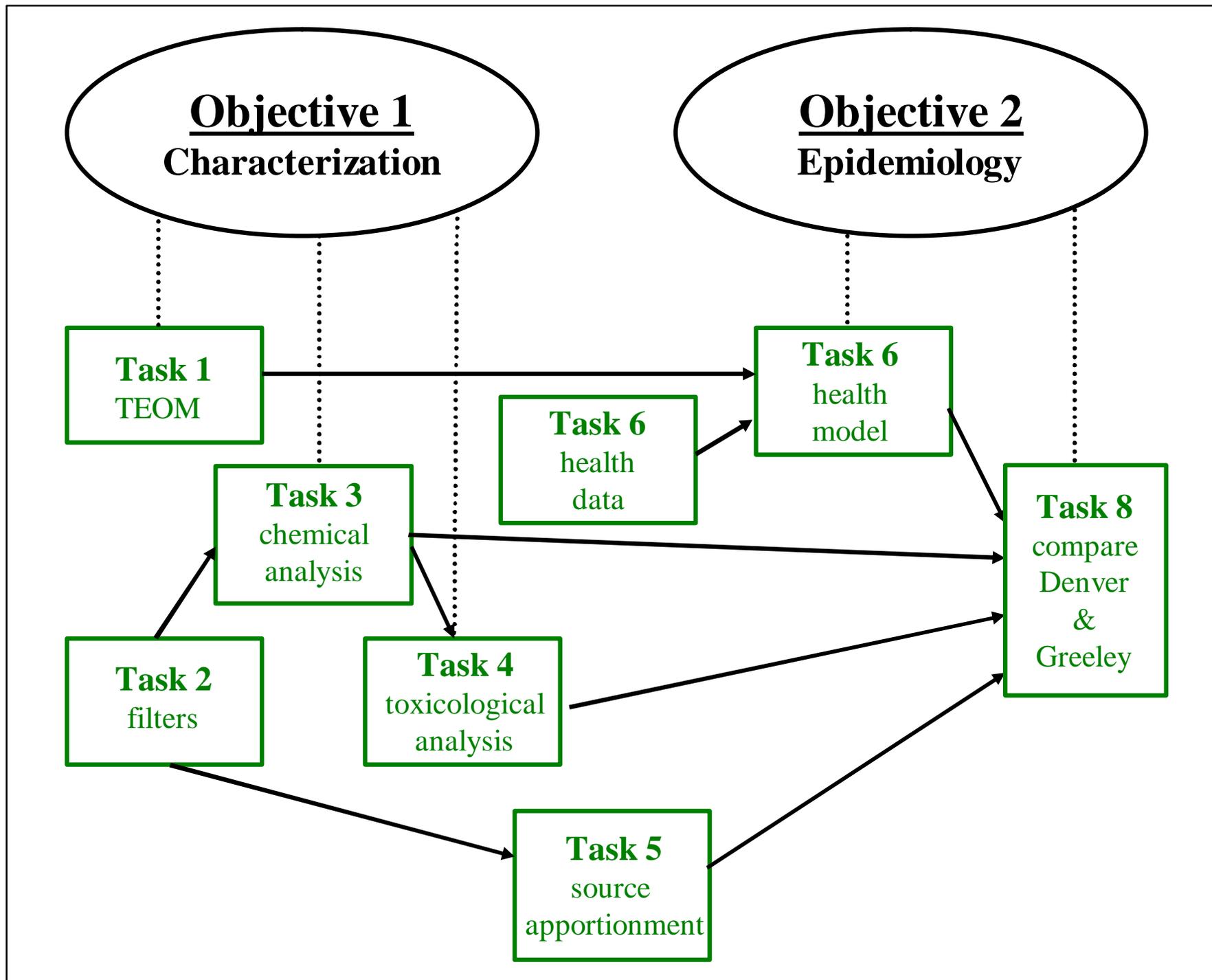
# What are we going to do?

## Objective 1 (Characterization)

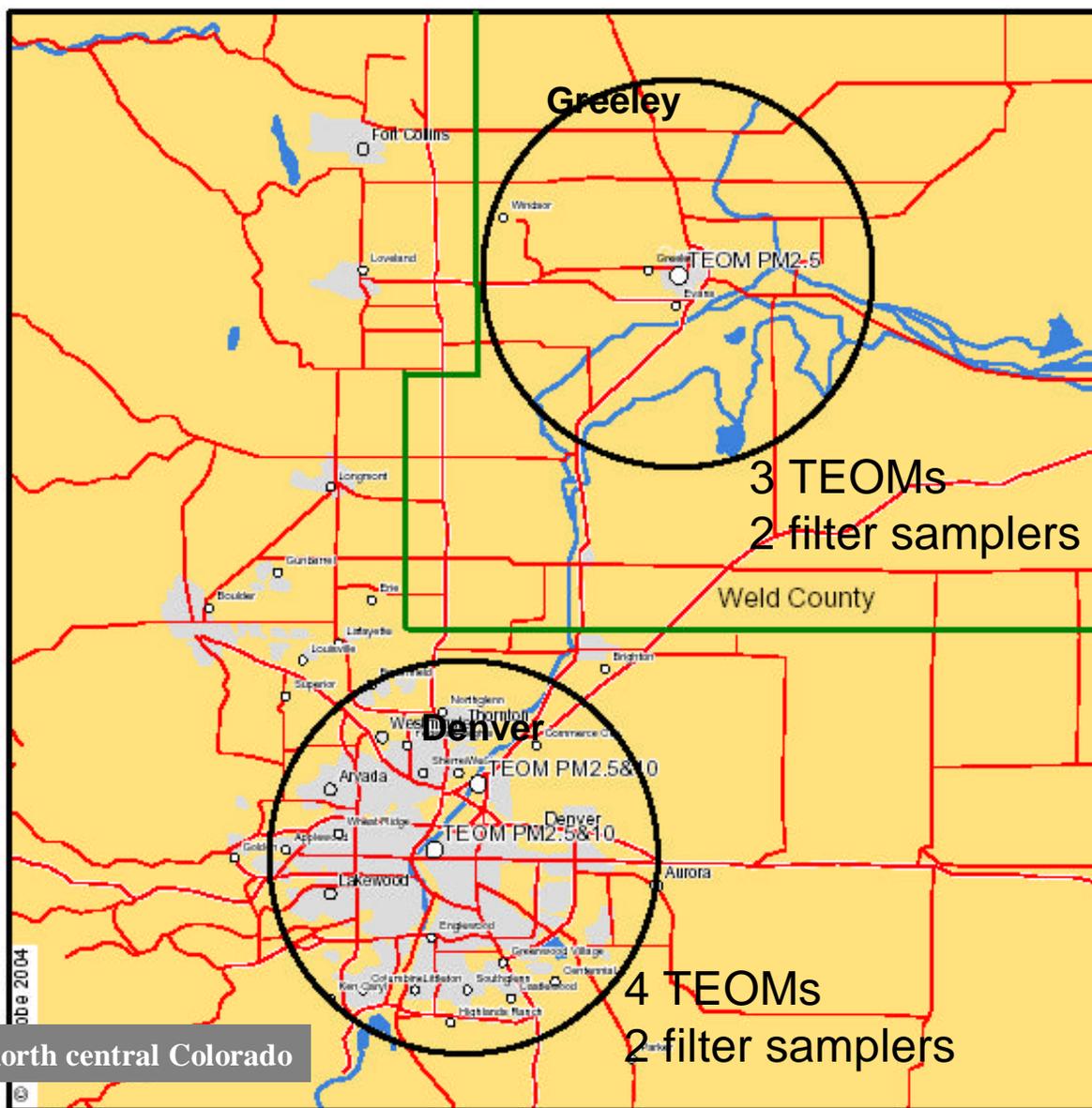
**Characterize  $PM_{coarse}$  mass, composition, toxicity, and origin in Denver and Greeley**

## Objective 2 (Health Effects)

**Evaluate the association of  $PM_{coarse}$  mass and several health outcomes in Denver & Greeley**



# Our Lab Urban – Rural Comparison



Map of study areas in north central Colorado

Greeley is the Weld County seat.  
 Weld County is the #1 agricultural county in Colorado and #8 in the US.  
 Ranks 2<sup>nd</sup> in the US in cattle and sheep inventory & sales (\$ 0.9 billion)

## Colorado Agriculture

### Total Value of Agricultural Products Sold by County

Data from 2002 Census of Agriculture, USDA

#### Colorado Ag Facts

Value of all agricultural products sold in 2002 totaled \$4.5 billion.

Agribusiness contributes \$16 billion to the state economy each year and employs more than 105,000 people.

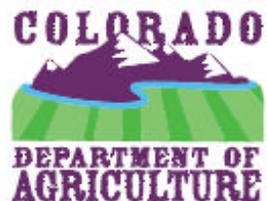
There are 31,389 farms in the state encompassing more than 31 million acres.

**LEGEND**

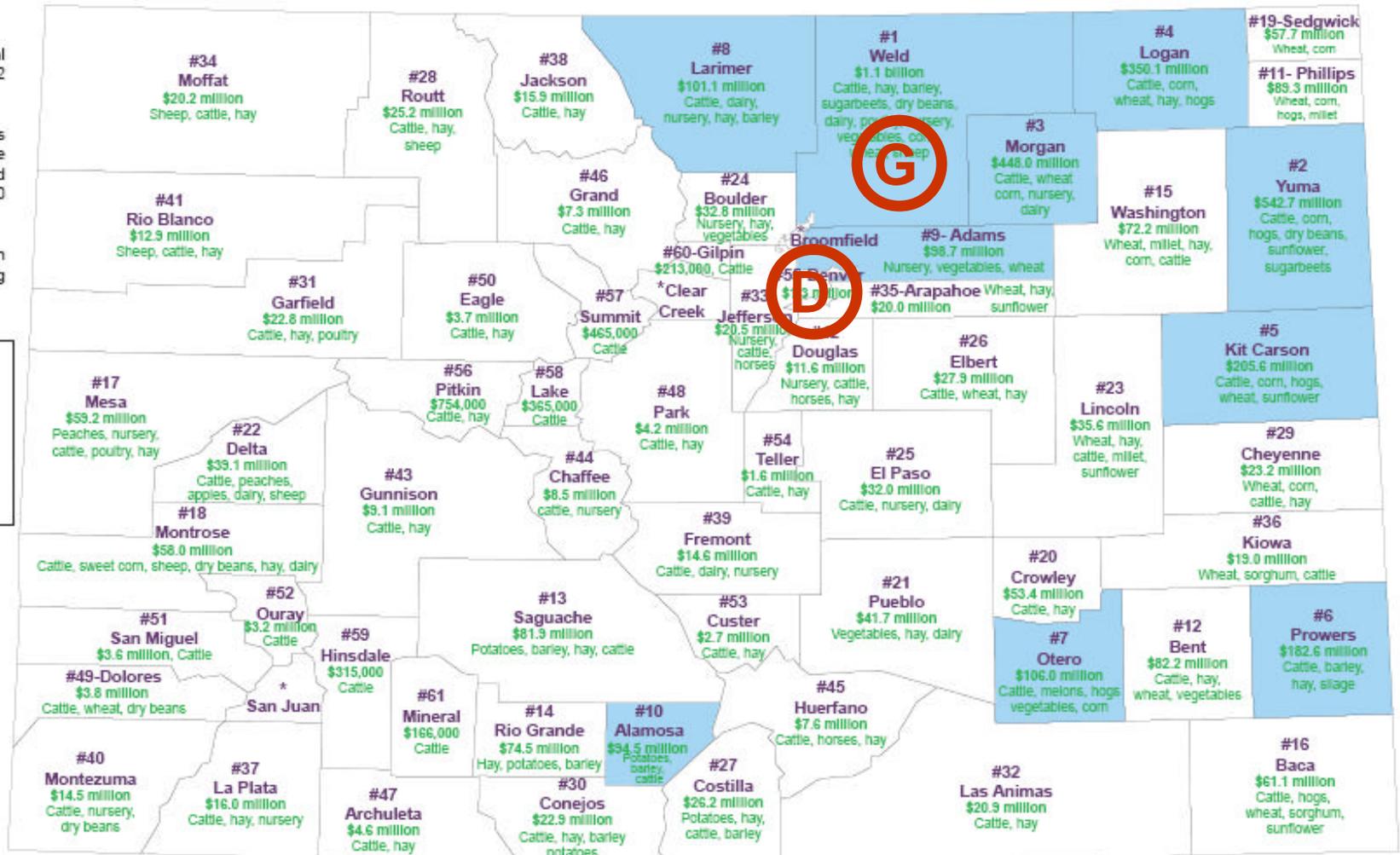
County Rank and Name  
 Total Value of Agricultural Products Sold  
 Top agricultural products

Shaded areas are top ten agricultural counties in Colorado.

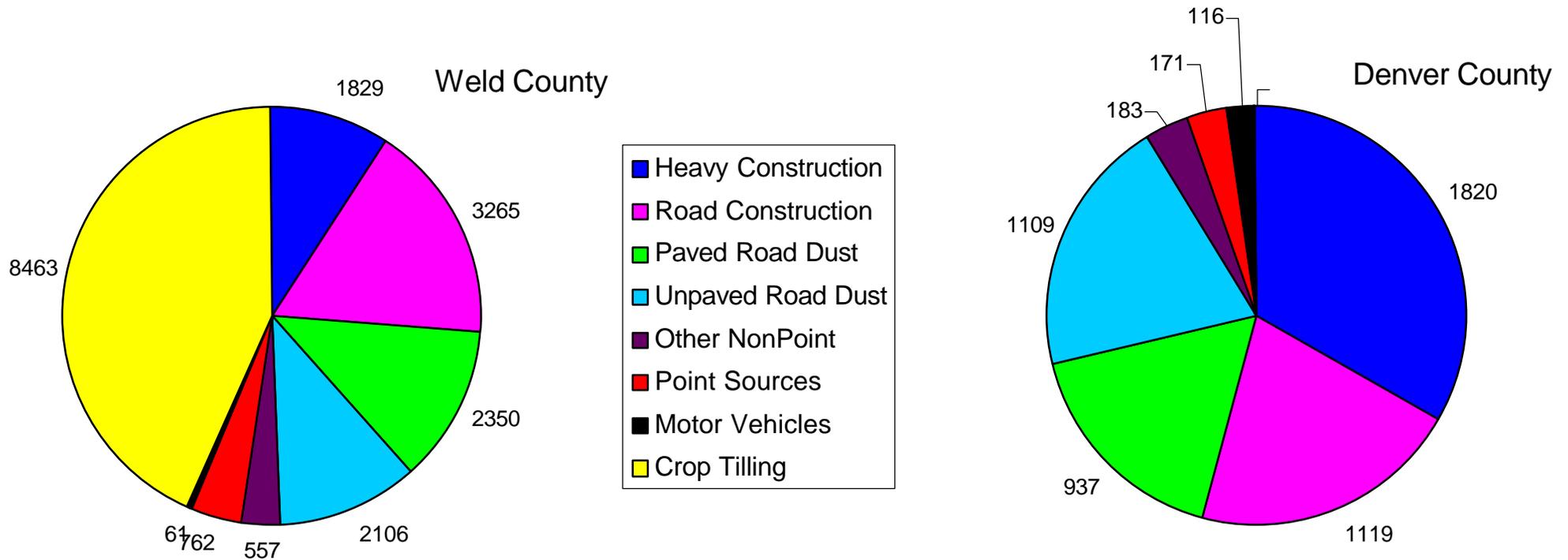
\*Data not available

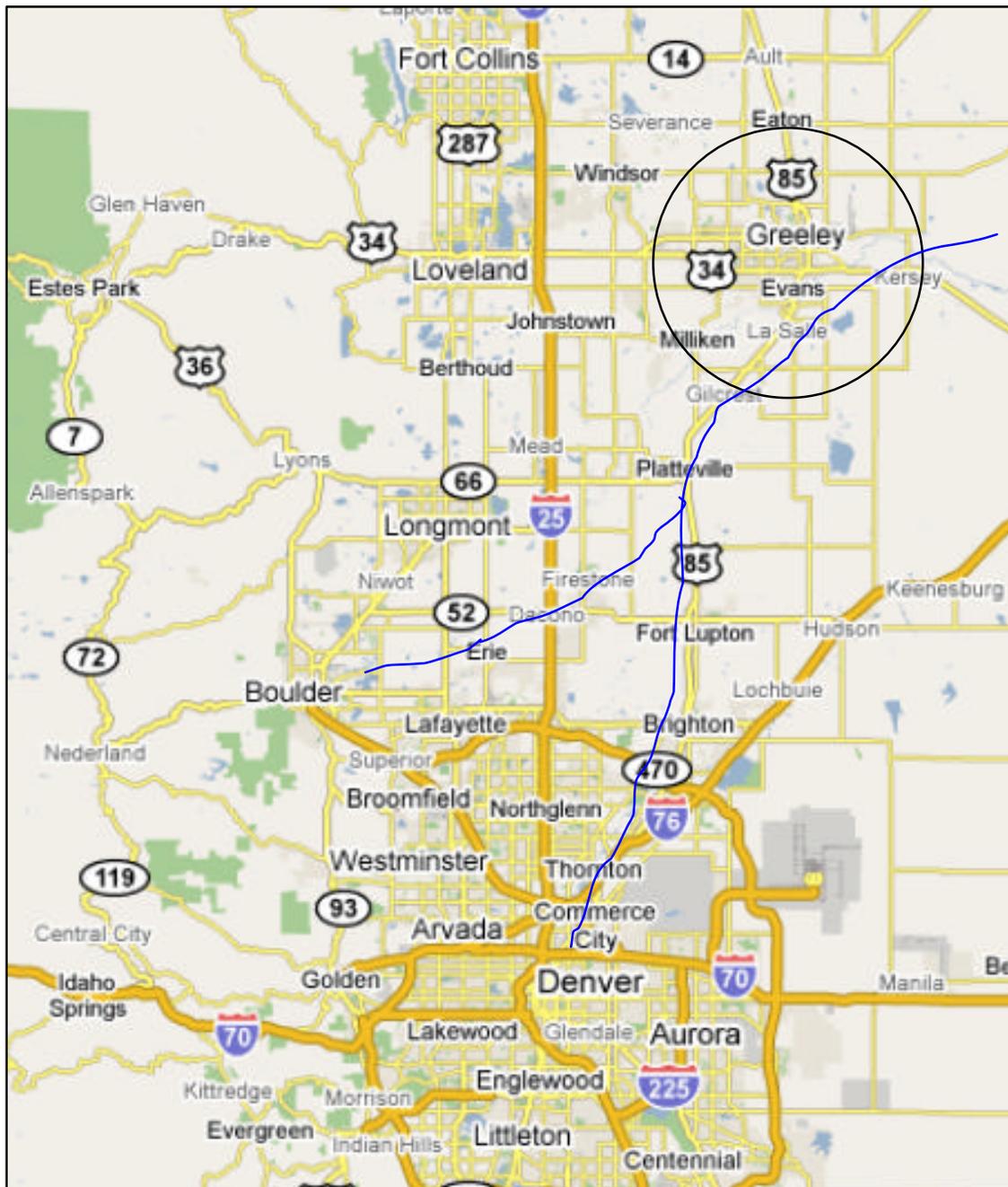


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[www.coloradoagriculture.com](http://www.coloradoagriculture.com)



# PM<sub>coarse</sub> Emissions Inventory





Greeley to Denver = 50 miles

Greeley demographics:

- Population (2005): 88,249
- Pop. change: +14.7% since 2000
- Median income: \$36,400
- Pop. = 65 yrs old: 10%
- African American: < 1%
- Hispanic: 29.5%

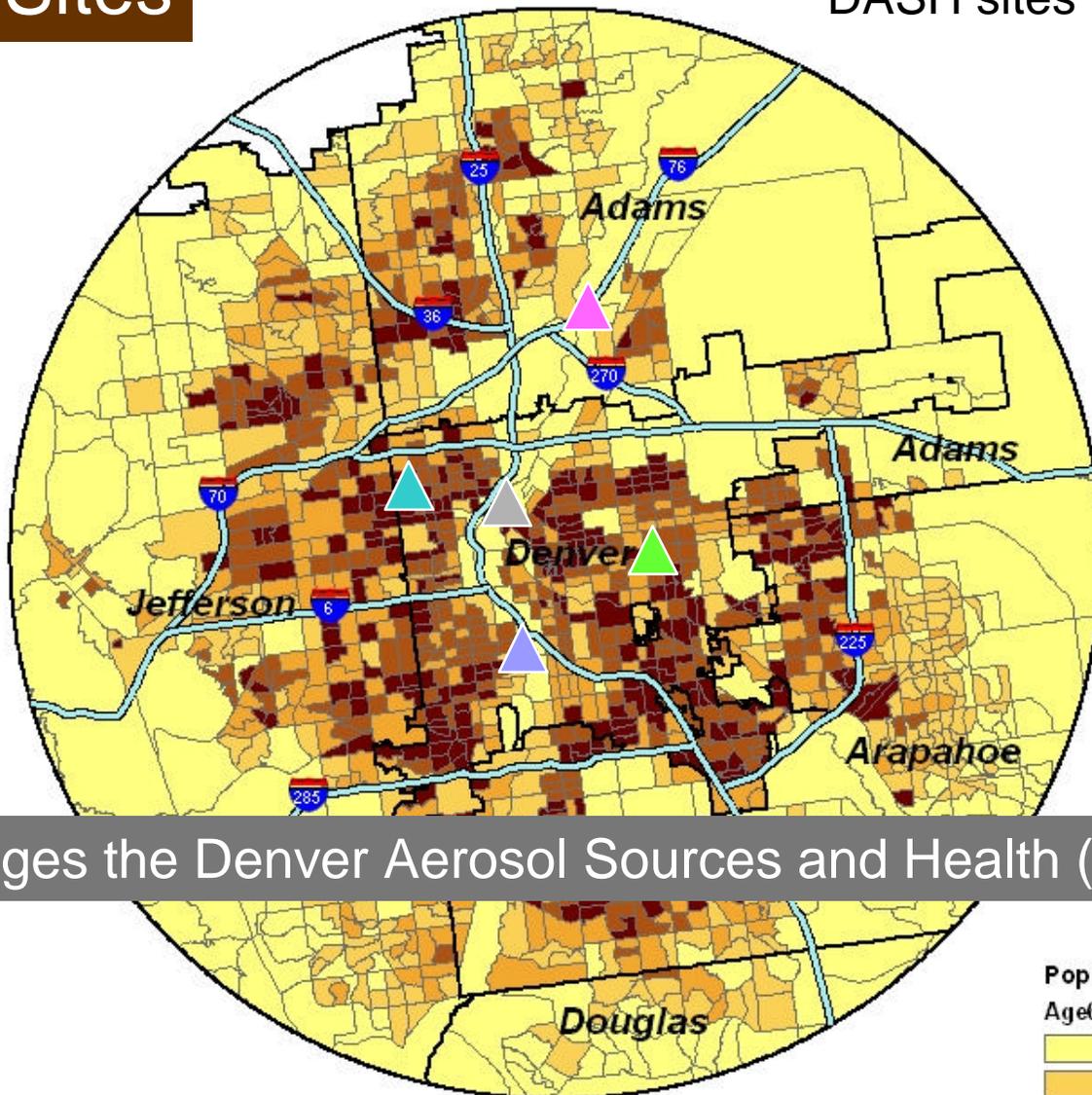
Denver demographics:

- Population (2005): 557,917
- Metro area pop.: 2.2 million
- Median income: \$39,500
- Pop. = 65 yrs old: 11%
- African American: 11%
- Hispanic: 32%

# Denver Sites

DASH sites

- ▲ NCORE
- ▲ Edison Elementary
- ▲ Alsup Elementary
- ▲ Palmer Elementary
- ▲ CAMP



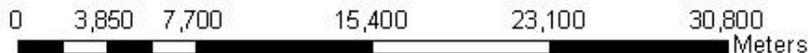
Leverages the Denver Aerosol Sources and Health (DASH) Study

Population density by block group

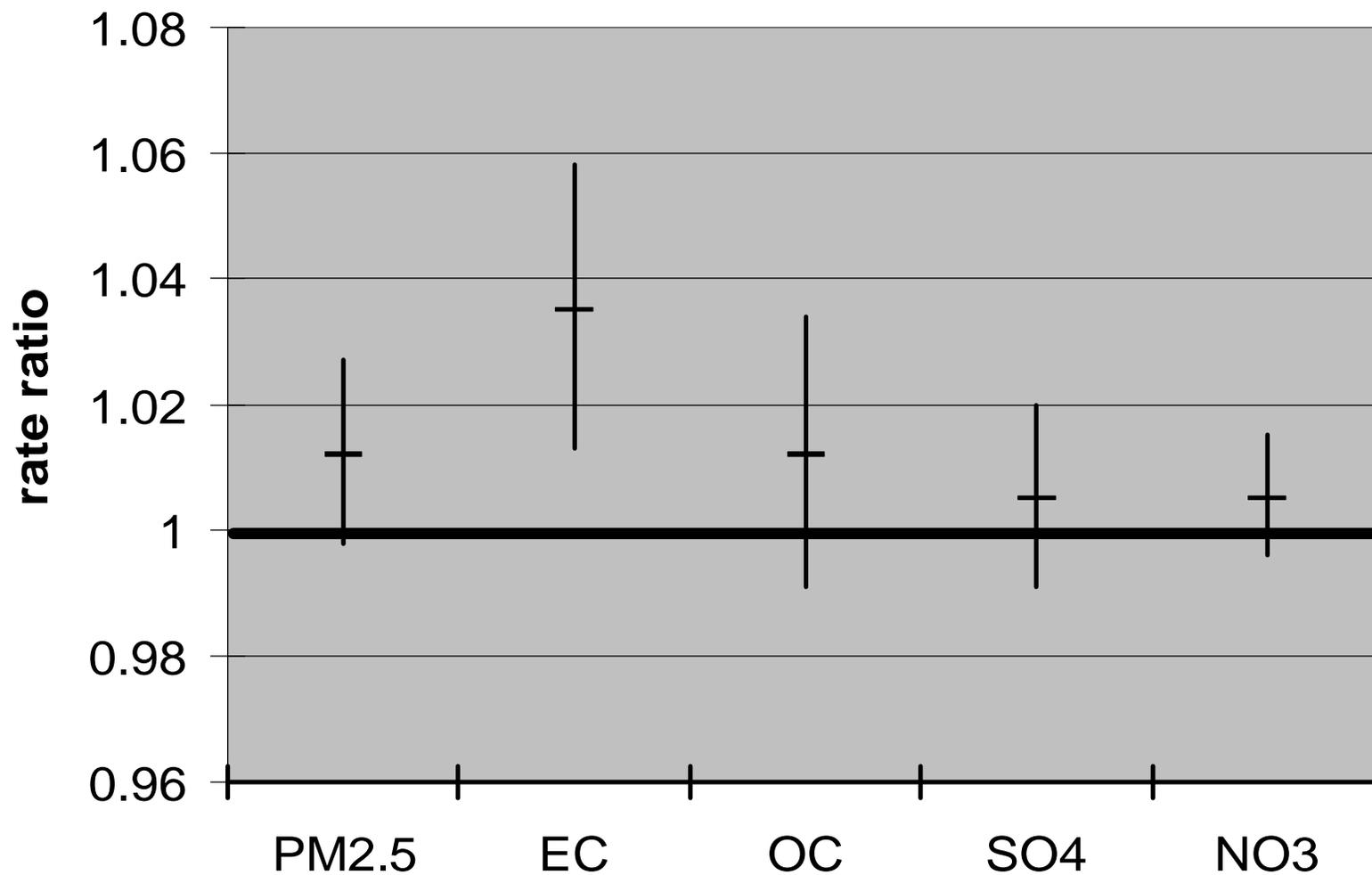
Age65\_SQMI

- 0 - 135
- 136 - 319
- 320 - 558
- 559 - 825
- 826 - 13039

Freeway and interstate highway

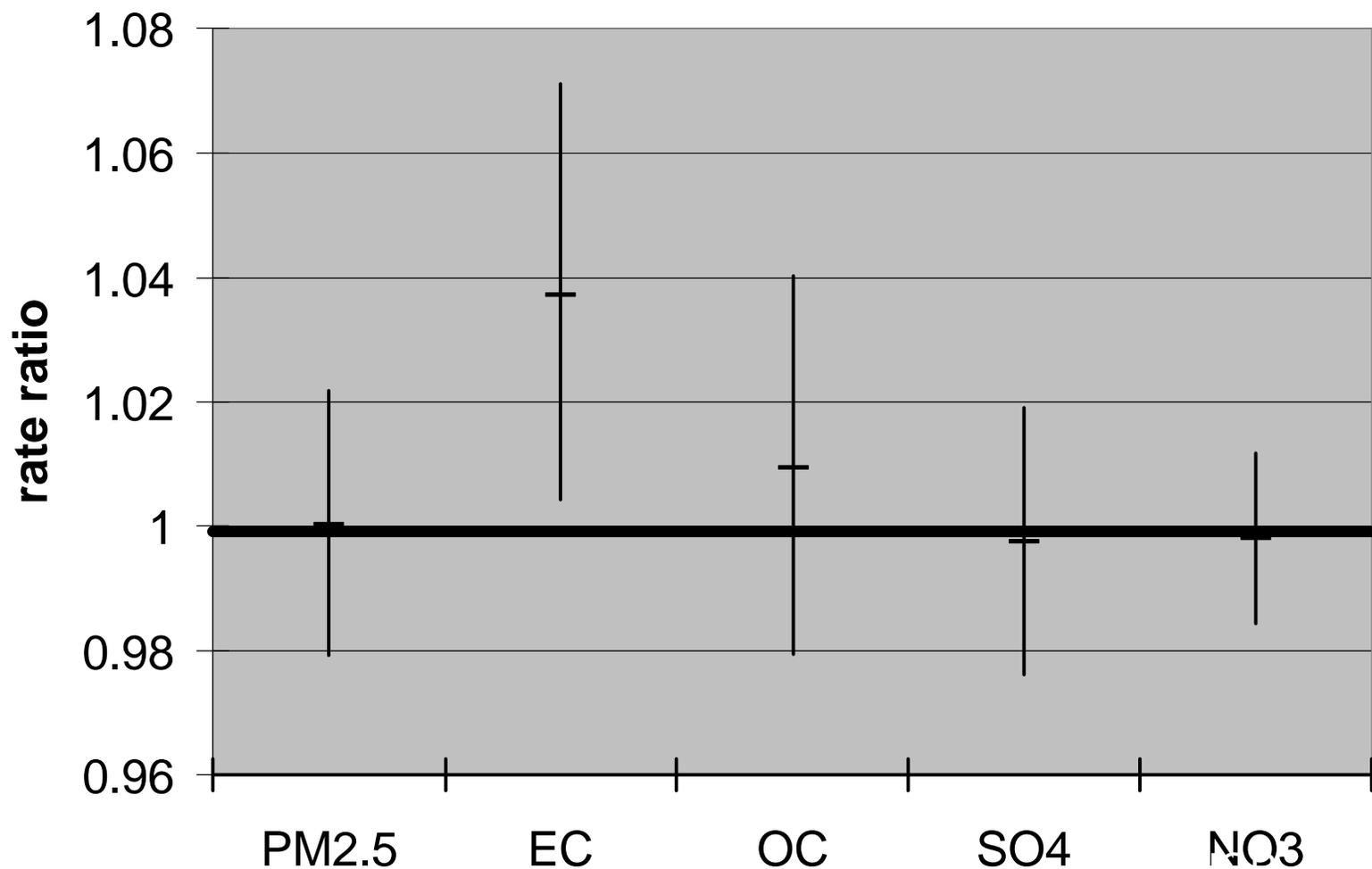


# DASH – Total Mortality



Daily PM2.5 – July 1, 2002 to present

# DASH – Cardio-Respiratory Mortality



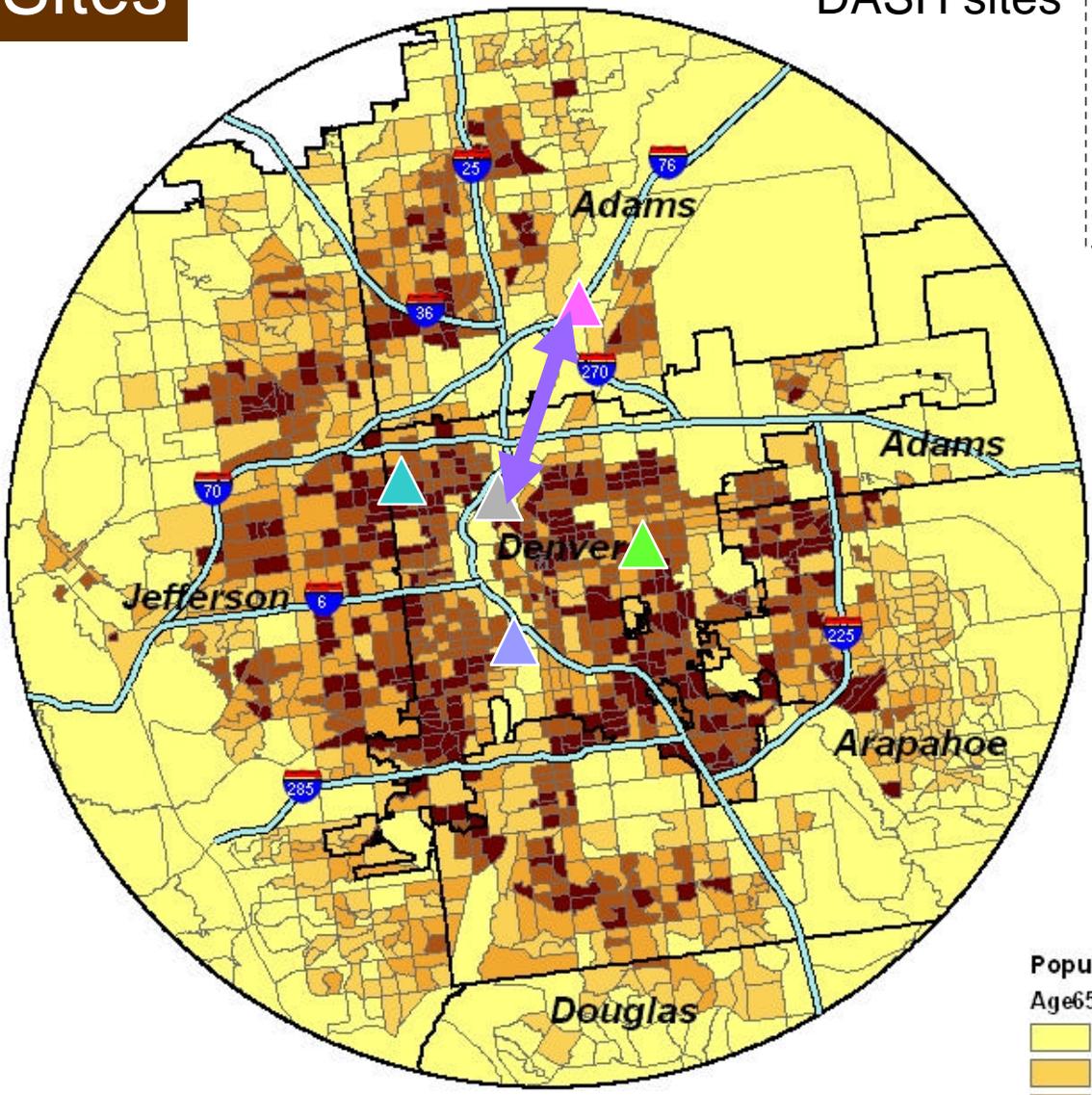
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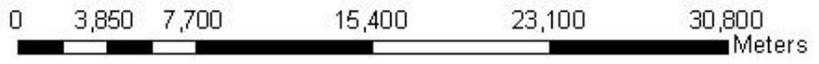


Population density by block group

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Freeway and interstate highway



# What do we know?

2005 concentrations

	CAMP		Commerce City		Greeley	
	PM2.5	PMcoarse	PM2.5	PMcoarse	PM2.5	PMcoarse
mean	10.50	14.82	8.28	21.18	7.58	14.50
stdev	5.88	8.44	4.76	12.22	4.13	8.47

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2005 concentration correlations

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CAMP	PM2.5						
	PMcoarse	-0.09					
Commerce City	PM2.5	0.44					
	PMcoarse		0.63	-0.02			
Greeley	PM2.5	0.60		0.60			
	PMcoarse		0.48		0.65	0.14	

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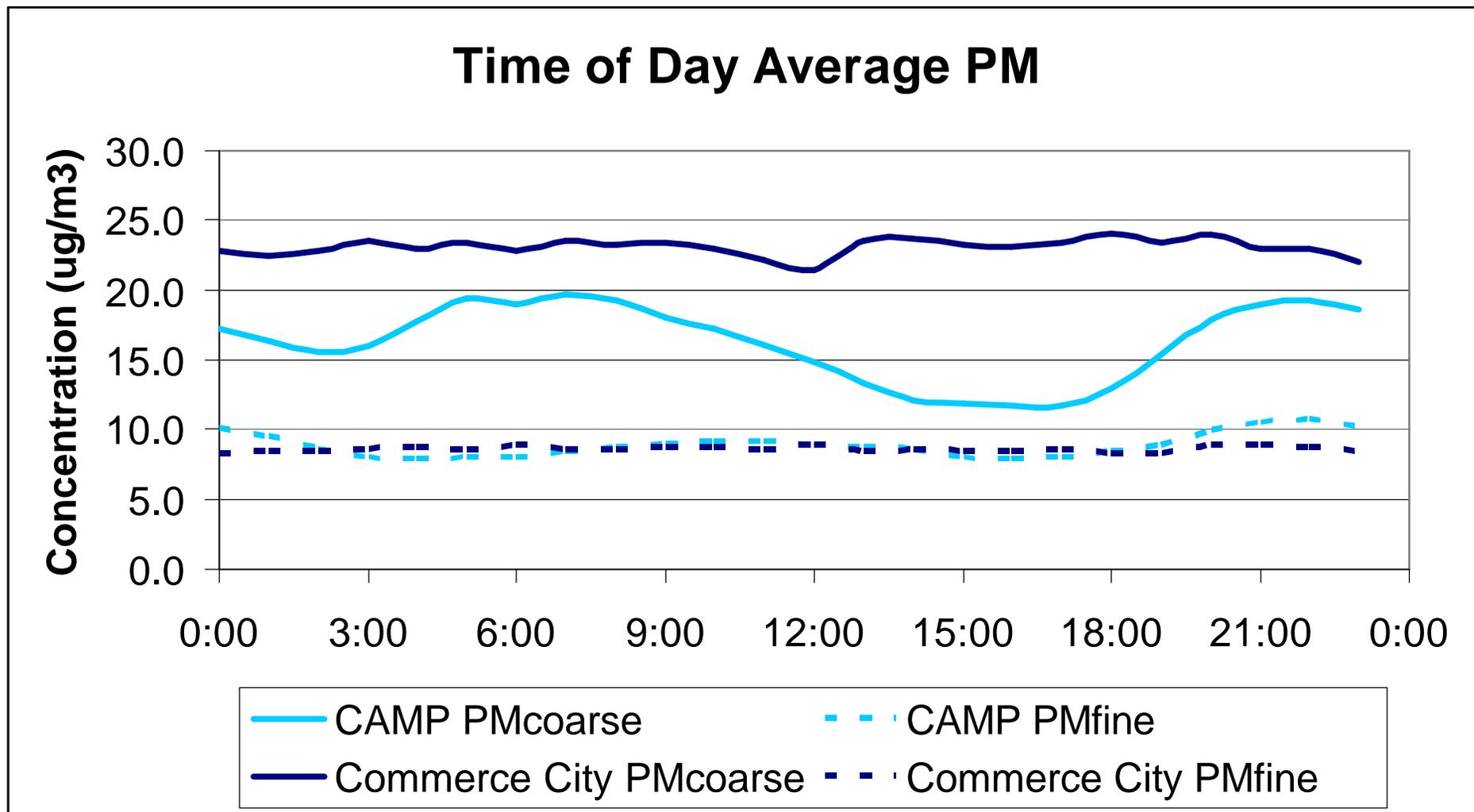
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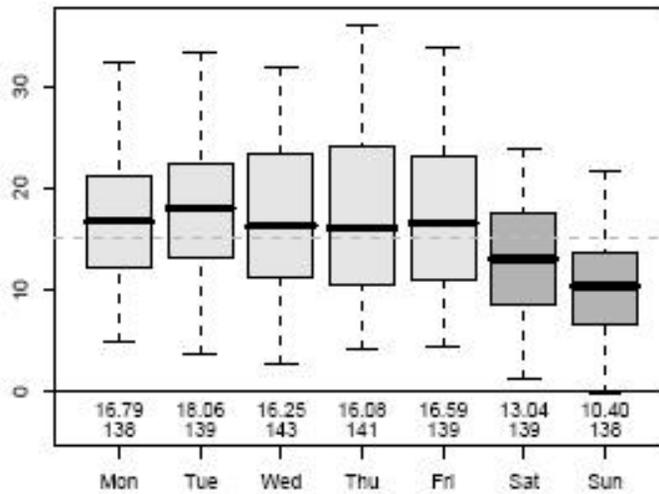
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# Data Analysis Examples

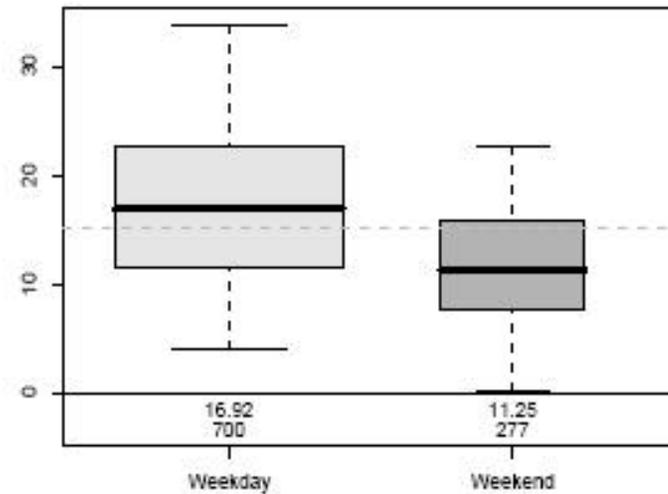


# Trends

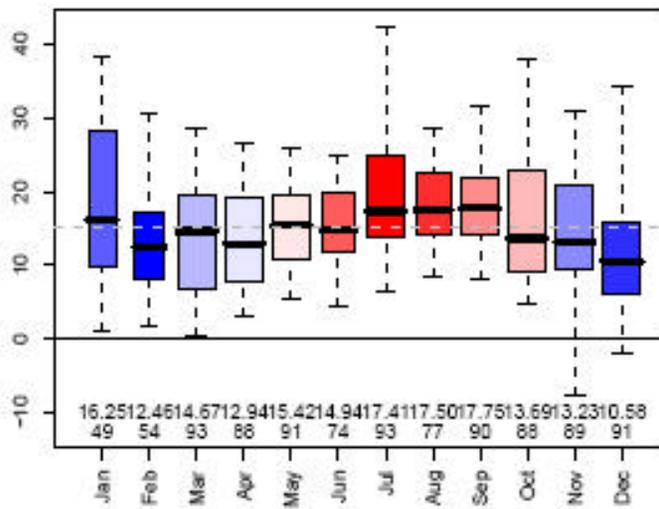
CAMP PMcoarse TEOM by Day of the Week



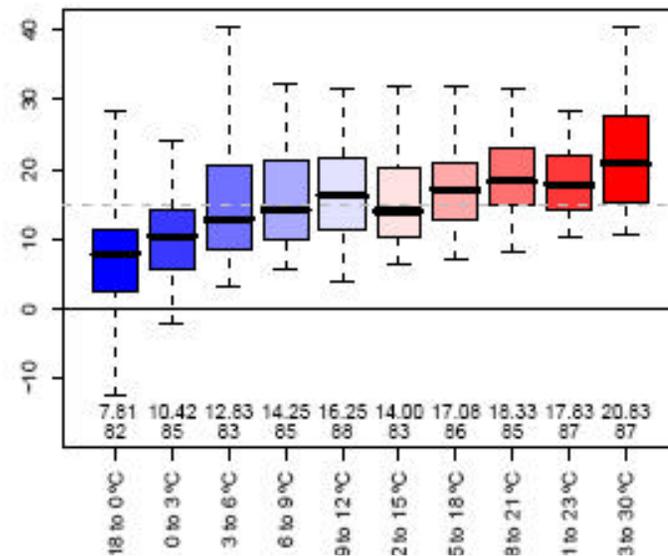
CAMP PMcoarse TEOM by Weekday/Weekend



CAMP PMcoarse TEOM by Month

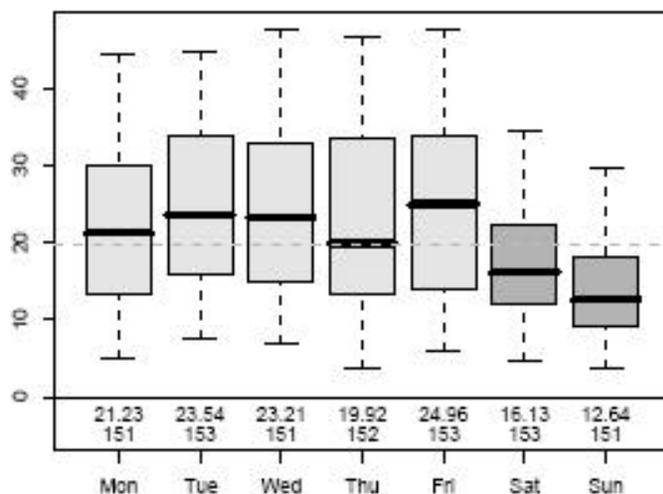


CAMP PMcoarse TEOM by Mean Temperature Decile

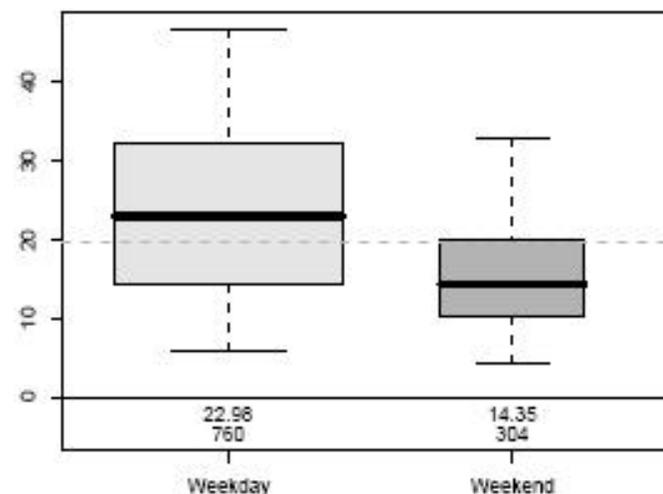


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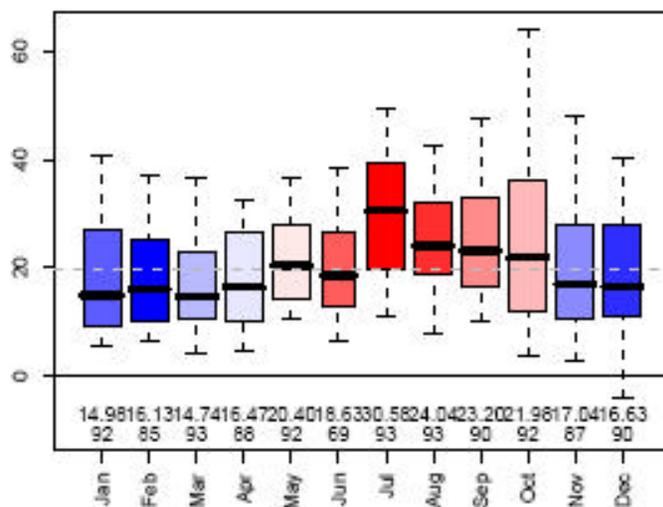
Commerce City PMcoarse TEOM by Day of the Week



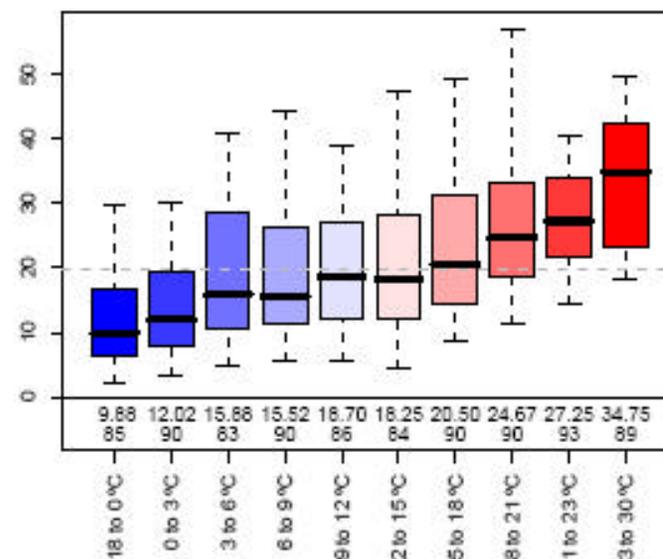
Commerce City PMcoarse TEOM by Weekday/Weekend



Commerce City PMcoarse TEOM by Month

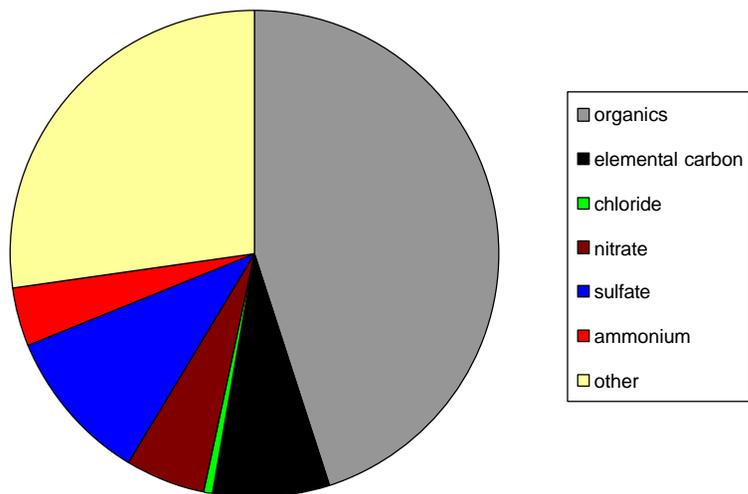


Commerce City PMcoarse TEOM by Mean Temperature Dec



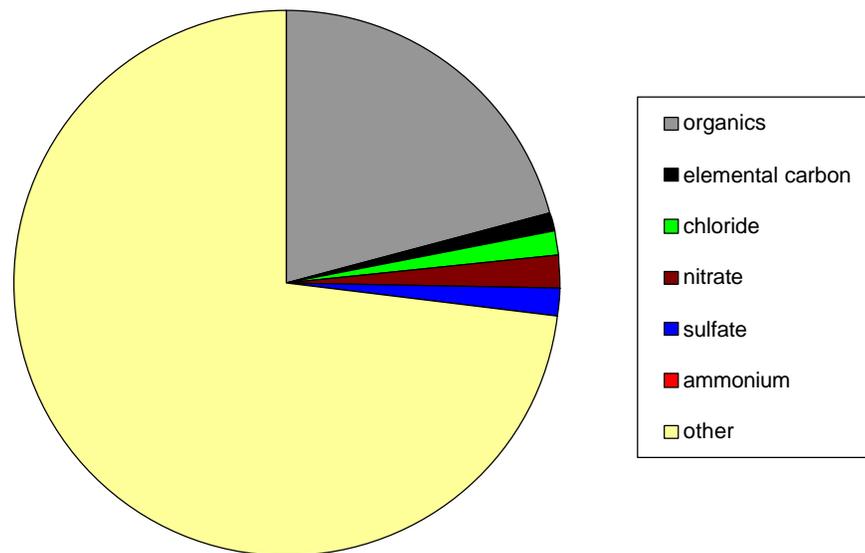
# Chemical Characterization

2001 Annual Average PM2.5



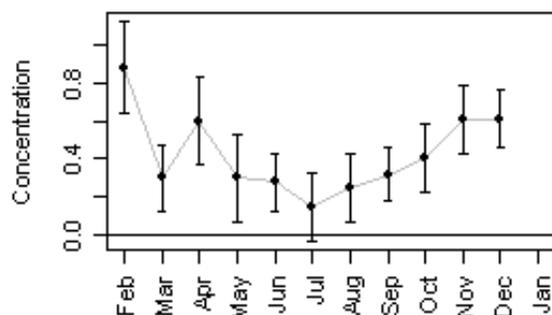
6<sup>th</sup> day sampling for 2001 at Alsup Elem.

2001 Annual Average PM10-2.5

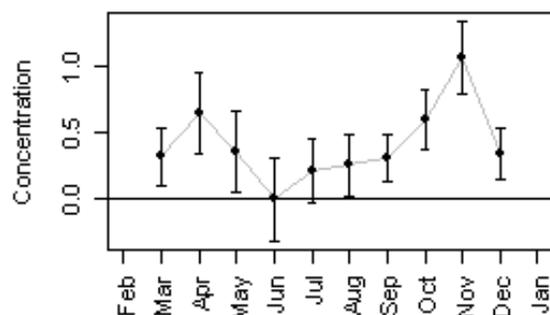


# Organics Origins?

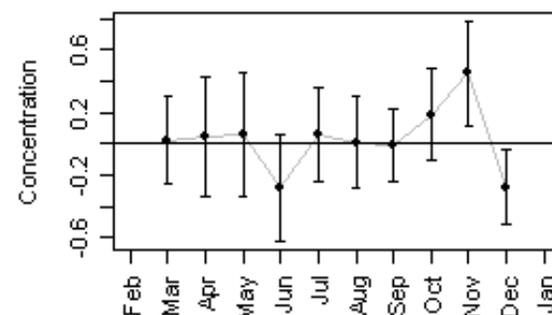
PM2.5 Benzo(ghi)perylene



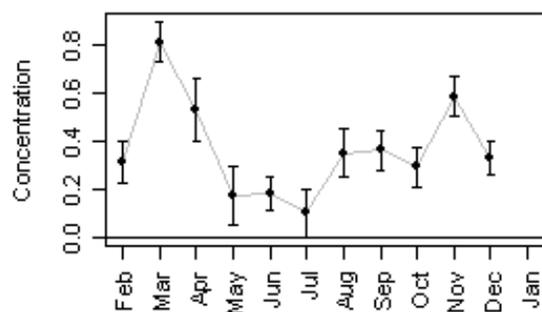
PM10 Benzo(ghi)perylene



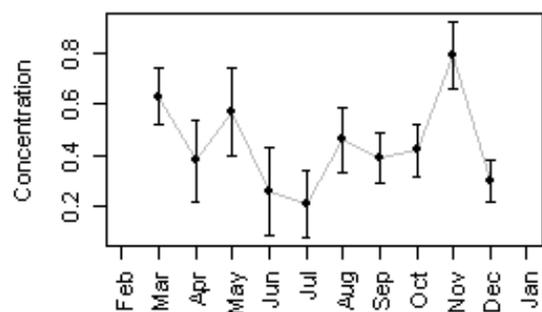
PM10-PM2.5 Benzo(ghi)perylene



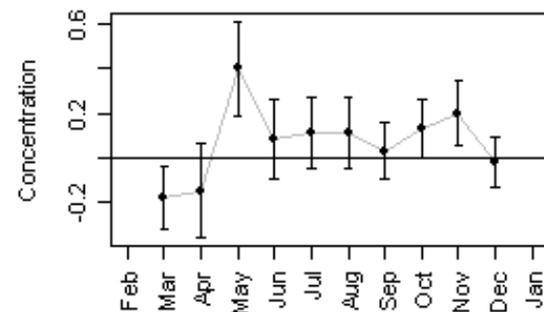
PM2.5 17a(H)-21b(H)-hopane



PM10 17a(H)-21b(H)-hopane

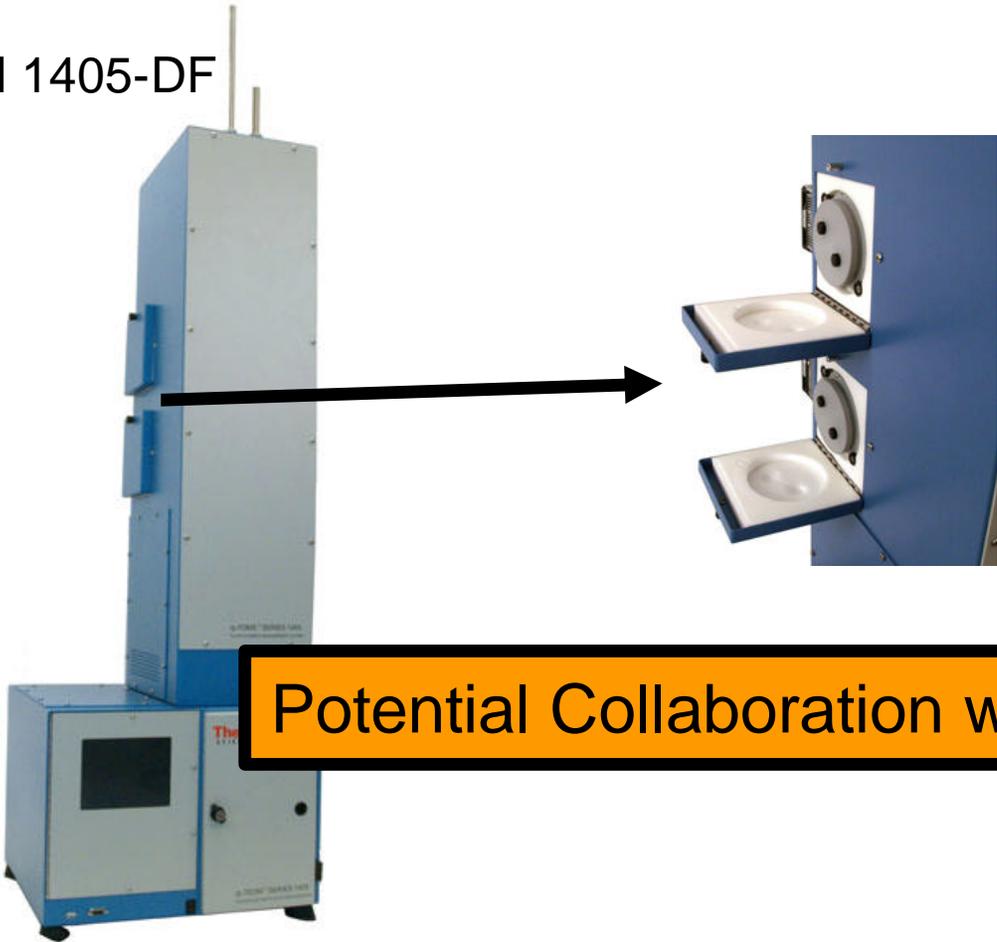


PM10-PM2.5 17a(H)-21b(H)-hopane



# Monitoring/Collection Tools

TEOM 1405-DF



Potential Collaboration with OAQPS



Mass Monitoring

Filter Collection

# Resultant Data

## $PM_{coarse}$ Characterization

1. Mass ← 3 years →

2. Ions (IC)

3. Bulk carbon (NIOSH 5040)

4. Water soluble C & N

5. Trace metals

6. Endotoxin

7. Total carbohydrates

8. Total proteins

9. Macrophage assays

ROS production & cytotoxicity

## Health Endpoints

1. Arrhythmic events

ICD patients

2. Respiratory ED visits

3. Cardiovascular ED visits

4. Preterm births

5. Intrauterine growth retardation

Filter measurements (200)

# Power Estimates

Outcome	Denver			Greeley		
	Number	OR/RR*	Power	Number	OR/RR*	Power
Arrhythmic events	1,200 event-days	1.05	0.98	600 event-days	1.05	0.89
		1.10	0.99		1.10	0.99
		1.20	0.99		1.20	0.99
Respiratory ED visits	50 visits / day	1.02	0.95	14 visits / day	1.02	0.64
		1.05	0.99		1.05	0.99
		1.10	0.99		1.10	0.99
Cardiovascular ED visits	20 visits / day	1.02	0.62	6 visits /day	1.02	0.32
		1.05	0.99		1.05	0.96
		1.10	0.99		1.10	0.99
Preterm births†	3,000	1.05	0.16	1,200	1.05	0.12
		1.10	0.48		1.10	0.36
		1.50	0.99		1.50	0.99

\*OR and RR per 10 µg/m<sup>3</sup> increase in coarse PM

† Approximately 10% of all births; IUGR will have similar power.

# Resulting Data Analysis

## Models to be evaluated

1. Source apportionment
2. Exposure assignment
3. Health outcome

**50 sets**

set = 2 Greeley vs 2 Denver

## Urban/Rural Comparison

1. Mass
2. Ions
3. Bulk carbon
4. Water soluble C & N
5. Trace metals
6. Endotoxin
7. Total carbohydrates
8. Total proteins
9. Macrophage bioassays
- 10. Sources**
- 11. CP mass effect estimate**